WHAT IS CLAIMED IS:

1. A carbon nanosheet having a thickness of 2 nanometers or less.

2. The carbon nanosheet of claim 1, wherein the thickness is 1 nanometer or less.

3. The carbon nanosheet of claim 1, wherein the carbon nanosheet comprises one to three graphene layers.

4. The carbon nanosheet of claim 3, wherein the carbon nanosheet comprises a single graphene layer.

5. The carbon nanosheet of claim 1, wherein the specific surface area of the carbon nanosheet is between 1000 m^2/g to 2600 m^2/g.

6. The composition of claim 1, wherein the carbon nanosheet has a height between 100 nm and 8 μm.

7. The carbon nanosheet of claim 1, wherein the carbon nanosheet is in substantially pure form.

8. The carbon nanosheet of claim 1, wherein the carbon nanosheet is a freestanding nanosheet disposed on its edge on a substrate.

9. The carbon nanosheet of claim 1, further comprising a plurality of carbon nanosheets having a thickness of 2 nm or less.

10. The carbon nanosheet of claim 9, wherein the plurality of carbon nanosheets are aligned.

11. A composition comprising a carbon nanoflake having a specific surface area between 1000 m^2/g and 2600 m^2/g.

12. The composition of claim 11, wherein the carbon nanoflake has a thickness of 10 nanometers or less.

13. The composition of claim 12, wherein the carbon nanoflake has a thickness of 5 nanometers or less.

14. The composition of claim 13, wherein the carbon nanoflake has a thickness of 2 nanometers or less.

15. The composition of claim 11, wherein the specific surface area of the carbon nanoflake is between 2000 m^2/g and 2600 m^2/g.

16. A method of making carbon nanoflakes comprising forming the nanoflakes on a substrate using RF-PECVD.

17. The method of claim 16, wherein RF-PECVD is inductively coupled.

18. The method of claim 16, wherein the RF-PECVD is capacitively coupled.

19. The method of claim 16, further comprising increasing the substrate temperature during nucleation phase of carbon nanoflake synthesis to form carbon nanosheets comprising a single graphene layer.

20. The method of claim 16, further comprising attaching a grounding electrode to the substrate during a nucleation phase of nanoflake formation on the substrate.

21. The method of claim 16, wherein the substrate temperature is between 550 °C and 950 °C.

22. The method of claim 16, wherein the PECVD chamber pressure is between 50 mTorr and 200 mTorr.

23. The method of claim 16, wherein PECVD plasma power is equal to or greater than 700 W.

24. The method of claim 16, wherein the CVD source gas comprises methane.

25. The method of claim 24, wherein the CVD source gas contains a methane to hydrogen ratio of between 0.05:99.95 and 100:0.

26. The method of claim 16, wherein the CVD source gas flow comprises acetylene.

27. The method of claim 24, wherein the CVD source gas contains an acetylene to hydrogen ratio between 0.05:99.95 and 60:40.

28. A method of making carbon nanosheets, comprising:
forming the nanosheets on a substrate; and
increasing the substrate temperature during a nucleation phase of carbon nanosheet formation.

29. The method of claim 28, wherein RF-PECVD is used to form the nanosheets.

30. The method of claim 29, wherein the RF-PECVD is inductively coupled.

31. The method of claim 29, wherein the RF-PECVD is capacitively coupled.

32. The method of claim 28, further comprising attaching a grounding electrode to the substrate during a nucleation phase of nanoflake formation on the substrate.

33. The method of claim 28, wherein the substrate temperature is between 550 °C and 950 °C.

34. The method of claim 33, wherein the substrate temperature is between 680 °C and 720 °C.

35. The method of claim 28, wherein the PECVD chamber pressure is between 50 mTorr and 200 mTorr.

36. The method of claim 28, wherein PECVD plasma power is equal to or greater than 700 W.

37. The method of claim 28, wherein the CVD source gas comprises methane.

38. The method of claim 37, wherein the CVD source gas contains a methane to hydrogen ratio of between 0.05:99.95 and 100:0.

39. The method of claim 28, wherein the CVD source gas flow comprises acetylene.

40. The method of claim 39, wherein the CVD source gas contains an acetylene to hydrogen ratio between 0.05:99.95 and 60:40.

41. A field emitter comprising carbon nanosheets of any one of claims 1-15.

42. A catalyst support comprising carbon nanosheets of any one of claims 1-15.

43. The catalyst support of claim 42, further comprising a catalyst comprising Pt.

44. The catalyst support of claim 42, further comprising a catalyst comprising nanoparticles.

45. A hydrogen storage device comprising carbon nanoflakes of any one of claims 7-15.

46. The device of claim 45, wherein the nanoflakes have a thickness of 2 nm or less.

47. A sensor comprising the nanoflakes of any one of claims 1-15.

48. A blackbody absorber comprising the nanoflakes of any of claims 1-15.

49. A composite material comprising the nanoflakes of any of claims 1-15.

50. The composite material of claim 49, further comprising a polymer material.

51. The nanoflakes of any one of claims 1-15, further comprising a coating.

52. The nanoflakes of claim 51, wherein the coating is selected from the group consisting of Pt, Ni, Ti, Zr, Hf, V, Nb, Ta, ZrC, and oxides and alloys thereof.

53. The nanoflake of claim 51, wherein the coating comprises a metal carbide coating.

54. A method of making coated carbon nanoflakes, comprising:

providing carbon nanoflakes coated with a metal coating; and

reacting the nanoflakes and the coating to convert the metal coating to a metal carbide coating.

55. The method of claim 54, wherein the step of reacting comprises heating the coated nanoflakes to react the metal with carbon in the nanoflakes.

56. The method of claim 54, wherein the nanoflakes comprise carbon nanosheets having a thickness of 2 nm or less and the metal coating comprises a Zr coating.